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(54) COPYING PAPER IN SHEET FORM

KOPIERPAPIER IN BLATTFORM

PAPIER POUR COPIE SOUS FORME DE FEUILLES

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Description

Technical field

The present invention relates to copying paper in sheet form having a surface weight of from 80 to 200 g/m^2. The copying paper is comprised of specific base paper and coating layer applied to at least one side of the base paper, preferably to both sides thereof. The coating layer has a surface weight of 12-18 g/m^2, which means, that the paper is fully coated, i.e. essentially the whole of the surface of the paper is covered with the coating layer. The above mentioned range of surface weight of from 80 to 200 g/m^2 refers to the surface weight of the base paper plus the surface weight of the coating layer, alternatively, of the coating layers.

Background art

There has developed over recent years a need for an improved copying paper which will enable other subjects than text to be copied thereon when desired and which will provide high quality print, for example high quality four colour reproduction. The paper is normally pre-printed and then used for copying purposes. One prerequisite for obtaining good quality print is that the paper is coated with pigment. Conventional copying paper is normally not coated and cannot therefore be used effectively for the intended purpose. Many types of copying paper are surface treated, for instance, with starch, polyvinyl alcohol, carboxymethyl cellulose, synthetic polymers, etc., and this surface treatment sometimes being called coating, but this type of coating in which the coating substances are applied in small quantities is quite different from pigment coating. By the just mentioned is meant the use, for instance, of calcium carbonate, clay, and many more pigments, either individually or in combination with one another and in relatively large quantities.

Rolls of paper of conventional offset quality and intended for combined printing and copying purposes are commercially available today. The use of this paper, however, is restricted to those types of copying machines, for instance laser printers, which are constructed for use with paper rolls. All copying machines which are designed for the use of sheet copy are unable to use copy paper in roll form. It has been found that when converting rolls of pre-printed paper to sheet form so as to enable said paper to be used with sheet feeding copying machines, problems arise with the runability of the machine, i.e. the sheets repeatedly cause stoppages.

Conventional copying paper has the aforesaid drawback, that a high quality print cannot be obtained.

Disclosure of the invention

Technical problem

It has been found difficult to combine good printability and good runability for one and the same copying paper in sheet form in copying machines, for example laser printers. One of the problems is that fully coated paper cannot be fed into the copying machine in a satisfactory manner, which results in repeated stoppages. This may be because of the friction of the paper. Another problem is that the paper mentioned is often unable to retain its original flat shape during the copying process, which also results in repeated stoppages.

Solution

The present invention provides a solution to the aforesaid problems and relates to a copying paper which comprises a base paper based on a fibre starting material of which at least 60% is comprised of short fibre pulp refined to 17-22° SR and of at least 20% long fibre pulp refined to 25-38° SR, together with filler in an amount of 19-28%, calculated on the base paper, and on at least one side of the base paper a coating layer of a surface weight of 12-18 g/m^2, the base component(s) of the coating layer including either

a) 100 parts of calcium carbonate distributed according to 60-80 parts of calcium carbonate of which 90% have a particle size beneath 2 µm and 40-20 parts of calcium carbonate of which 95% have a particle size beneath 2 µm; or

b) 60-90 parts of calcium carbonate of which 90% have a particle size beneath 2 µm and 40-10 parts of kaolin clay of selected particle size quality;

and the surface coating also including at least binder and hardener.

The binder preferably consists of starch and/or latex. It is especially preferred that the starch is oxidized and that the latex is of the open styrene butadiene type. The starch is preferably added in an amount of 5-7% calculated on dry pigment or base component(s). Latex is preferably added in an amount of 6-8%, calculated on dry pigment or base component(s). This applies to the addition of both of these chemicals to the coating color and later the paper. If only one of these chemicals is used, the aforesaid quantity must be increased. It is preferred that the hardener is free from

formalin. For instance, glyoxal can be used in an amount of 0.5-1.5% calculated on dry pigment or base component (s). Other hardeners that can be used are ammonium zirconium carbonate, ethanedial, which is a polymer containing tetra-hydro-4-hydroxy-5-methyl-2-(1H) pyrimidinone and which is propoxylated and a hardener retailed under the trade name Nopcote 1670 which contains an imidazoline compound, which is a reaction product of glyoxal and urea.

According to one embodiment of the invention, the coating layer, and therewith the paper, contains 1-3 parts of stearate, preferably calcium stearate or ammonium stearate, calculated on 100 parts of base component(s).

The dry solids content of the coating color, and therewith also of the newly applied coating layer, shall lie within the range 65-70%.

It is absolutely preferred that the copying paper shows a coating layer on its both sides.

The filler present in the copying paper may be any known filler whatsoever, although calcium carbonate is preferred.

With regard to applying print to the copying paper, this is normally done prior to copying. Mentioned printing may be effected either on paper which has already been converted to sheet form or on paper which is in roll form. In this latter case, the paper must be converted to sheet form prior to the copying stage.

Coating colors of the aforedescribed kind primarily result in a mat paper, i.e. a paper whose gloss is beneath 20% measured in accordance with Lehman (70-degree incident light).

Within the scope of the invention it is also possible to produce a glossy paper. In this case, the composition of the coating color will differ slightly from the composition which provides an optimal mat copying paper and possibly prefers an extra chemical addition.

Advantages

The copying paper according to the invention has good printability as well as good runability in copying machines. By choosing the correct base paper and a coating layer of correct composition, it has been found possible to achieve the same reliability in the copying machine with regard to preprinted copying paper as that achieved with conventional copying paper. The frequency at which stoppages occur in the machine when using the copying paper according to the invention is extremely low. Naturally, the paper according to the invention can be run efficiently and effectively through copying machines as unprinted paper. Furthermore, the chemicals from which the coating layer is comprised are relatively inexpensive in combination, therewith enabling the price of the copying paper to be kept at a relatively low level.

Best mode of carrying out the invention

The copying paper according to the invention will below be described in more detail, and the portion is ended with a working embodiment. As mentioned before, the fibre composition of the base paper shall comprise at least 60% of short fibre pulp and at least 20% of long fibre pulp. By short fibre pulp is meant chemical pulp, preferably sulphate pulp, manufactured for instance from hardwood, such as birch, eucalyptus, beech, aspen, and similar types of wood. By long fibre pulp is meant chemical pulp, preferably sulphate pulp, manufactured for instance from softwood, such as pine, spruce, and other types of wood. Another usable chemical pulp is sulphite pulp.

The remaining 20% of the fibre composition may consist of one of the two aforesaid types of pulp or of a mixture thereof. It is also fully possible to mix in other types of pulps, such as sulphite pulp and/or high yield pulp, such as mechanical pulp for instance. The fibre composition of the base paper, refinement of the different pulps and the filler content of the paper shall be adapted so that the finished paper has low curling tendencies (reactivity). By curling is meant that the paper deviates from the flat shape and adopts varying curved shapes.

It applies throughout, that the pulps shall be refined only to a moderate extent, i.e. the paper shall be imparted other refinement dependent properties to the best possible extent, while at the same time fulfilling the aforesaid conditions. The various pulps are refined separately to the refinement levels earlier mentioned in °SR, i.e. degrees Schopper-Riegler.

The filler shall be present in an amount of 19-28%, preferably 20-25%, calculated on the base paper. The filler is preferably calcium carbonate in different forms, such as chalk, ground marble and calcium carbonate precipitates. It is also possible, however, to use other fillers, either totally or partially, such as kaolin clay, talcum and gypsum ($CaSO_4$).

The manner in which the base paper is constructed and produced is highly significant to the ability to run the finished paper in copying machines. The composition of the coating layer is highly significant to the runability of the paper in copying machines, and sometimes a decisive significance. The quantity of coating substance applied is also significant to some extent.

The coating layer or layers of the inventive copying paper is/are produced from one of two coating colors.

The pigment or base component of one color consists of 100 parts calcium carbonate. Calcium carbonate having different particle size distributions is available and the calcium carbonate is said to have different degrees of fineness, such as fine, superfine, etc. In this case, 60-80 parts of such calcium carbonate is used, of which 90% of the particles

have a size beneath 2 um and 40-20 parts of a still finer calcium carbonate, namely a calcium carbonate of which 95% of the particles have a size beneath 2 um. In addition to the earlier mentioned ingredients in the form of binder and hardener, the color may also include an optical whitener, different types of tinting colours, and a substance for adjusting the pH of the color. Examples of such substances include sodium hydroxide and ammonium. The amounts in which the binder and hardener are present have been given in the aforegoing. The remaining chemicals are present in a very small quantity, i.e. in an amount of 1 part or less. Additional chemicals may also be added to the color.

The pigment or base component of the other color comprises 60-90 parts calcium carbonate, where 90% of the particles have a size smaller than 2 um, and 40-10 parts of kaolin clay of SPS quality. SPS is an acronym of the English language designation "selected particle size". This color also includes binder and hardener in the aforesaid quantities. The color may also include an optical whitener, tinting color and an alkali for adjusting the pH of the color, etc. The color will also preferably include a comparatively large quantity of stearate. Mentioned additive has been found to provide the copying paper with good runability in copying machines. The stearate probably assists in imparting the correct surface property to the paper and above all the correct friction. Stearate may also be added to the first color.

With regard to the aforesaid two coating colors, it can be mentioned that the use of starch as a binder in top coatings is normally avoided, since starch causes pronounced binder migration, which results in mottling. One advantage afforded by the addition of starch is that the paper obtains good stiffness and good toner adhesion, and starch also prevents the paper from becoming sticky and adhering to copying machine surfaces when it is exposed to high temperatures. It is not thought that stearate has earlier been used in coating colors in the aforesaid quantities.

According to one preferred embodiment of the invention, both sides of the copying paper are provided with a coating layer. In this case, the paper is coated in a two station coating machine. As previously mentioned, the coating color shall have a relatively high dry solids content, namely within the interval 65-70%. Subsequent to coating the paper, the paper is dried first on the one coated side and then on the other side. The first coated side of the paper is dried in a manner such that the paper will include 6-9% water and drying of the other side of the paper is continued until the paper has a water content of 4-5%.

Manufacturing and properties of a copying paper in accordance with the invention are below described in an Example in comparison with manufacturing and properties of copying paper outside the invention.

Example 1

A base paper was produced on a 6.5 m wide Valmet type paper machine in the following manner :

Three different types of pulp fibres were mixed together in the following quantities: Birch sulphate pulp = 70%; pine sulphate pulp = 24%; and spruce sulphite pulp = 6%. The three pulps were refined separately to the following degrees of refinement, prior to being mixed together: Birch pulp = 18°SR; pine pulp = 34°SR; and spruce pulp = 18°SR.

Filler, mainly calcium carbonate, was supplied in an amount of 21.2% in finished paper. 131 kg of filler were supplied for each tonne of paper in dispersion while the remaining filler was supplied via incoming paper broke. The stock also contained the following chemicals:

Starch (cationic active)	= 4.5 kg/tonne paper
Size (alkyd ketene dimer)	= 8.5 " "
Retention agent 1 (polyacrylamide)	= 1.7 " "
Retention agent 2 (bentonite clay)	= 0.16 " "
Optical whitener (Blankophor P)	= 0.4 " "
Tinting colour (ethyl violet)	= 0.02 " "

The paper was surface sized with an 8%-surface sizing starch in a quantity of about 3 g/m^2.

The aforedescribed base paper had a surface weight of 97 g/m^2 and the coating colors A, B and C were applied to the paper. The coating color A was applied to the base paper both in a pilot coating machine and in a full scale test, whereas the coating colors B and C were applied to the base paper solely in the pilot coating machine. The three coating colors had the following compositions.

A

80 parts calcium carbonate retailed under the trade name Hydrocarb 90, in a 75%-dispersion. 90% of this calcium carbonate has a particle size smaller than 2 um. 20 parts of the SPS-coating clay (kaolin), which was dispersed with 0.2 parts polyacrylate to a dry solids content of 68%.

These two pigments, or base components, were mixed together. There were then added.

6 parts of styrene butadiene latex retailed under the trade name Dow 905; and
6 parts oxidized starch retailed under the trade name Cerestar 05595, boiled to a dry solids content of about 32%.

There was then added in the following order:

0.8 parts hardener (glyoxal);
2 parts calcium stearate retailed under the trade name Nopcoat C104;
0.8 parts optical whitener retailed under the trade name Blankophor PC;
0.001 parts tinting colour (levanyl violet).

The color was brought to a pH = 8.5, by adding ammonium. The color had a dry solids content of 65%.

B

80 parts calcium carbonate retailed under the trade name Hydrocarb 90 in a 75%-dispersion. 90% of this calcium carbonate has a particle size smaller than 2 um.
20 parts calcium carbonate retailed under the trade name Setacarb in a 75%-dispersion. 95% of this calcium carbonate has a particle size smaller than 2 um.
These two pigments, or base components, were mixed together. There were then added:

6 parts styrene butadiene latex, retailed under the trade name Dow 905; and
6 parts oxidized starch, retailed under the trade name Cerestar 05595, boiled to a dry solids content of about 32%.

There were then added in the following order:

0.8 parts hardener (glyoxal);
0.8 parts optical whitener retailed under the trade name Blankophor PC;
0.001 parts tinting colour (levanyl violet).

The color was brought to pH = 8.5, by adding ammonium. The color had a dry solids content of 68%.

C

100 parts SPC-coating clay (kaolin) dispersed with 0.2 parts polyacrylate to a dry solids content of 65%.
Added to the clay were:

6 parts styrene butadiene latex retailed under the trade name Dow 905; and
6 parts oxidized starch retailed under the trade name Cerestar 05595, boiled to a dry solids content of about 32%.

Added in the following order were:

0.8 parts hardener (glyoxal);
0.8 parts optical whitener retailed under the trade name Blankophor PC;
0.001 parts tinting colour (levanyl violet).

The color was brought to pH = 8.5 by adding ammonium. The color had a dry solids content of 59%.

The coatings were applied under realistic conditions, partly on a pilot coating machine (the colors A, B and C) having curved blades, at a speed of 800 m/minute and partly on a full-scale Jagenberg coating machine (color A) having a width of 3.3 m and curved blads at a speed of 800 m/- minute. The base paper was coated on both sides in all instances, with an amount of color corresponding to 16 g/m^2. The finished, coated paper had a surface weight of 130 g/m^2. All paper coated had a mat finish according to the earier given definition.

With regard to the ability of running the paper through copying machines, it has been found that in order to obtain good runability, the friction of different material shall be the following.

The friction between the feed belt and the paper shall be greater than the friction between the retard belt and the paper, which in turn shall be greater than the friction between paper and paper.

The friction between the different materials, including the four papers, was measured according to ASTM (Americal Society for Testing and Materials) D1894.

In one case, friction was measured by measuring the friction generated between the feed belt and the felt side of

the paper (FS) and, in the other case, between the feed belt and the wire side (WS) of the paper. Similar measurement was made with regard to the retard belt and the paper. Both static and kinetic friction were measured on the papers. The results are set forth in the following Table 1.

Table 1

Friction in grams							
Test	Color	Feed belt/paper		Retard belt/paper		Paper/Paper	
		FS	WS	FS	WS	Static	Kinetic
Full scale	A	292	262	260	257	110	80
Pilot	A	232	235	170	162	83	60
Pilot	B	440	372	258	255	122	94
Pilot	C	505	468	143	200	66	65

Other tests have shown that when mixing solely clay as the pigment or when mixing excessively large quantities of clay in the coating pastes, the runability of the paper in all copying machines is influenced negatively, such as in the case of the paper Pilot C. Furthermore, the exclusion of the stearate addition in the paper produced in accordance with Full Scale A and Pilot A resulted in impaired runability of the paper in all copying machines.

It has been found that the difference between static and kinetic friction of the paper mirrors the runability of the paper in copying machines. Double paper feed and other phenomena which can cause stoppages in the copying machines have been found to increase with decreasing differences in static and kinetic friction of the paper.

The numerical values were repeated from Table 1, and the difference between the numerical values can be seen from the following Table 2.

Table 2

Friction in grams			
Test	Color	Static/Kinetic	Difference
Full Scale	A	110/80	30
Pilot	A	83/60	23
Pilot	B	122/94	28
Pilot	C	66/65	1

The first three papers in the above Tables are in accordance with the invention, whereas the fourth paper was not, i.e. the coating color C was applied to this fourth paper. The difference between the static and kinetic friction of the inventive papers is 23 or more, whereas the corresponding difference of the non inventive paper (0-sample) is as small as 1. In order for the copying paper to be totally satisfactory and to have totally satisfactory runability, a standard has been set whereby 5 000 copies (simplex) and 3 000 copies (duplex) can be copied in sequence without causing a machine stoppage. By simplex is meant that copies are made on only one side of the paper, while duplex means that copies are made on both sides of the paper.

All four papers were tested on four Rank Xerox copying machines, designated 4050, 4090, 5090 and 9700. 5 000 copies were taken with the aforesaid three inventive papers without the occurrence of a stoppage, both with simplex and duplex copying, whereas the non inventive paper, i.e. the 0-sample, resulted in more than one stoppage with each 1 000 copies taken, with both simplex and duplex copying.

These tests show that the content of the paper coating layer, or in other words the coating layer construction, is decisively significant to the behaviour of the paper when fed into a copying machine and during the document copying process. In this case, the reference sample (0-sample) has also been provided with a base paper constructed in accordance with the invention. If the coating color C had been applied to some other kind of base paper, the difference in runability of the paper in the copying machine between the papers would have been still more pronounced.

Claims

1. A copying paper comprising a base paper based on fibre starting material of which at least 60% is a short fibre pulp refined to 17-22°SR and at least 20% is a long fibre pulp refined to 25-38°SR, and filler to an amount of 19-28%, calculated on the base paper, and on at least one side of the base paper a coating layer of a surface

weight of 12-18 g/m^2, the base component(s) of the coating layer including either

a) 100 parts of calcium carbonate distributed according to 60-80 parts of calcium carbonate of which 90% have a particle size beneath 2 µm, and 40-20 parts of calcium carbonate of which 95% have a particle size beneath 2 µm;

or

b) 60-90 parts of calcium carbonate of which 90% have a particle size beneath 2 µm, and 40-10 parts of kaolin clay of selected particle size quality;

and the surface coating also including at least binder and hardener.

2. A copying paper according to Claim 1 wherein the binder consists of starch and/or latex.

3. A copying paper according to Claim 2 wherein the starch is oxidized and the latex is of open styrene butadiene type.

4. A copying paper according to Claim 1 wherein the hardener contains no formalin.

5. A copying paper according to Claims 1-4 wherein the coating layer includes 1-3 parts stearate, preferably calcium stearate or ammonium stearate, calculated on 100 parts base component(s).

6. A copying paper according to Claims 1-5 wherein, when newly applied, the coating layer has a dry solids content of 65-70%.

7. A copying paper according to Claims 1-6 wherein the coating layer is applied to both sides of the base paper.

8. A copying paper according to Claims 1-7 wherein the filler is calcium carbonate.

9. A copying paper according to Claims 1-8 wherein the paper is converted to sheet form prior to taking a copy.

Patentansprüche

1. Kopierpapier umfassend ein Rohpapier, welches auf einem Faserausgangsmaterial, von dem mindestens 60% ein auf 17 - 22°SR raffinierter kurz faseriger Zellstoff und mindestens 20% ein auf 25 - 38°SR raffinierter langfaseriger Zellstoff ist, und einen Füllstoff in einer Menge von 19 - 28%, auf das Rohpapier gerechnet, basiert, und eine Überzugsschicht mit einem Flächengewicht von 12 - 18 g/m^2 auf mindestens einer Seite des Rohpapiers, wobei die Basiskomponente(n) der Überzugsschicht entweder

a) 100 Teile an Calciumcarbonat, welches gemäß 60 - 80 Teile an Calciumcarbonat, von dem 90% eine Teilchengröße von unter 2 µm besitzen, und 40 - 20 Teilen an Calciumcarbonat, von dem 95% eine Teilchengröße von unter 2 µm besitzen, verteilt ist;
oder

b) 60 - 90 Teile an Calciumcarbonat, von dem 90% eine Teilchengröße von unter 2 µm besitzen, und 40 - 10 Teile an Kaolinton der Qualität mit selektierten Teilchengrößen

enthalten, und die Überzugsschicht ebenfalls mindestens ein Bindemittel und ein Härtungsmittel enthält.

2. Kopierpapier gemäß Anspruch 1, wobei das Bindemittel aus Stärke und/oder Latex besteht.

3. Kopierpapier gemäß Anspruch 2, wobei die Stärke oxydiert ist und der Latex vom offenen Styrol-Butadien-Typ ist.

4. Kopierpapier gemäß Anspruch 1, wobei das Härtungsmittel kein Formalin enthält.

5. Kopierpapier gemäß den Ansprüchen 1 - 4, wobei die Überzugsschicht 1 - 3 Teile an Stearat, vorzugsweise Calciumstearat oder Ammoniumstearat enthält, berechnet auf 100 Teile der Basiskomponente(n).

6. Kopierpapier gemäß den Ansprüchen 1 - 5, wobei die Überzugsschicht einen Trockenfeststoffgehalt von 65 - 70% enthält, wenn sie neu aufgebracht ist.

7. Kopierpapier gemäß den Ansprüchen 1 - 6, wobei die Überzugsschicht auf beide Seiten des Rohpapiers aufgebracht ist.

8. Kopierpapier gemäß den Ansprüchen 1 - 7, wobei der Füllstoff Calciumcarbonat ist.

9. Kopierpapier gemäß den Ansprüchen 1 - 8, wobei das Papier vor dem Aufnehmen einer Kopie in eine Blattform überführt wird.

Revendications

1. Papier de copie comprenant une base de papier réalisée en matière fibreuse et comprenant au moins 60% de pulpe à fibres courtes raffinée à 17-22°SR, et au moins 20% de pulpe à fibres longues raffinées à 25-38°SR et un remplisseur dans une proportion de 19-28%, calculée sur la base de papier et, sur au moins un côté de la base de papier, une couche de revêtement dont le grammage est compris entre 12 et 18 g/m2, le(s) composant(s) de base de la couche de revêtement incluant :

   a) 100 parties de carbonate de calcium comprenant 60 à 90 parties de carbonate de calcium duquel 90% a une taille de particules inférieure à 2 µm, et 40 à 20 parties de carbonate de calcium dont 95% a une taille de particules inférieure à 2 µm;
   ou
   b) 60 à 90 parties du carbonate de calcium dont 90% a une taille de particules inférieure à 2 µm et 40 à 10 parties de kaolin à taille de particules sélectionnées, le revêtement de surface incluant également au moins un liant et un durcisseur.

2. Papier de copie selon la revendication 1, dans lequel le liant consiste en de l'amidon et/ou du latex.

3. Papier de copie selon la revendication 2, caractérisé en ce que l'amidon est oxydé et que le latex est de type butadiène styrène ouvert.

4. Papier de copie selon la revendication 1, dans lequel le durcisseur ne contient de formol.

5. Papier de copie selon les revendications 1 à 4, dans lequel la couche de revêtement inclût une à trois parties de stéarate, de préférence du stéarate de calcium ou d'ammonium, pour 100 parties de composant(s) de base.

6. Papier de copie selon les revendications 1 à 5, dans lequel, lorsqu'elle est nouvellement appliquée, la couche de revêtement a un contenu en matière sèche de 65 à 70%.

7. Papier de copie selon les revendications 1 à 6, dans lequel la couche de revêtement est appliquée des deux côtés de la base en papier.

8. Papier de copie selon les revendications 1 à 7, dans lequel le remplisseur est du carbonate de calcium.

9. Papier de copie selon les revendications 1 à 8, dans lequel le papier est converti en feuilles avant d'effectuer une copie.